

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims

1.-156. (Cancelled)

157. (Currently Amended) ~~A switch according to claim 156 comprising~~ An optical fiber cross-connect switch comprising first and second groups of optical fiber switching units, disposed in optically opposing relation, each of the switching units in at least one of said first and second groups further comprising:

an optical fiber operative to conduct optical signals;

a position encoder comprising a reticle having a spatially varying pattern of interaction with radiation incident thereon, the encoder operative to detect a Moiré interference pattern and determine therefrom a position of at least one of: (i) an end of said optical fiber; (ii) an optical element operative to influence an optical path of optical signals associated with said fiber; and (iii) a plurality of optical elements operative to influence an optical path of optical signals associated with said signal emitted from or coupled into the fiber; and

an optical system configured to project one or more control signal radiation patterns.

158. (Previously Presented) A switch according to claim 157 wherein the reticle is positioned to receive the one or more control signal radiation patterns and to produce one or more corresponding Moiré interference patterns in response thereto.

159. (Previously Presented) A switch according to claim 158 wherein the encoder comprises a radiation sensor which is positioned to detect at least a portion of the one or more corresponding Moiré interference patterns and configured to generate a corresponding control signal in response thereto.

160. (Previously Presented) A switch according to claim 159 comprising a controller connected to receive the corresponding control signal and configured to determine a position of the reticle based on the corresponding control signal.
161. (Previously Presented) A switch according to claim 159 wherein the reticle has a spatially varying transmissivity and wherein the radiation sensor is located to detect radiation from the one or more control signal radiation patterns which have passed through the reticle.
162. (Previously Presented) A switch according to claim 159 wherein the reticle has a spatially varying reflectivity and wherein the radiation sensor is located to detect radiation from the one or more control signal radiation patterns which have reflected from the reticle.
163. (Previously Presented) A switch according to claim 159 wherein the reticle is patterned with a regular array of cells.
164. (Previously Presented) A switch according to claim 163 wherein each cell comprises an aperture portion and an opaque portion and wherein the reticle passes a first proportion of the control signal radiation patterns incident on the aperture portion to the radiation sensor and the reticle passes a second proportion, smaller than the first proportion, of the control signal radiation patterns incident on the opaque portion to the radiation sensor.

165. (Previously Presented) A switch according to claim 159 wherein the reticle comprises a circularly symmetric pattern of aperture areas and opaque areas and wherein the reticle passes a first proportion of the control signal radiation patterns incident on the aperture areas to the radiation sensor and the reticle passes a second proportion, smaller than the first proportion, of the control signal radiation patterns incident on the opaque areas to the radiation sensor.
166. (Previously Presented) A switch according to claim 159 wherein each of the one or more control signal radiation patterns comprises a plurality of elongated stripes of radiation.
167. (Previously Presented) A switch according to claim 159 wherein each of the one or more control signal radiation patterns comprises a spatially periodic radiation pattern.
168. (Previously Presented) A switch according to claim 163 wherein each of the one or more control signal radiation patterns comprises a spatially periodic radiation pattern having a period substantially equal to a spatial periodicity of the array of cells.
169. (Previously Presented) A switch according to claim 168 wherein the cells of the array of cells are arranged in rows extending substantially parallel to a first axis and columns extending substantially parallel to a second axis and wherein each of the one or more control signal radiation patterns comprises a plurality of elongated stripes which are oriented substantially parallel to one of the first and second axes.
170. (Previously Presented) A switch according to claim 159 wherein the one or more control signal radiation patterns comprise at least one radiation pattern having a first wavelength and at least one radiation pattern having a second wavelength.

171. (Previously Presented) A switch according to claim 159 wherein the optical system comprises an array of radiation emitting devices which are located in positions optically opposing one of: the first group of optical fiber switching units and the second group of optical fiber switching units.
172. (Previously Presented) A switch according to claim 171 wherein the optical system is configured to project the one or more control signal radiation patterns by turning on selected pluralities of the radiation emitting devices.
173. (Previously Presented) A switch according to claim 171 wherein individual ones of the radiation emitting devices are located between a plurality of optical switching units in the first group of optical fiber switching units.
174. (Previously Presented) A switch according to claim 171 wherein individual ones of the radiation emitting devices are located between a plurality of optical switching units in the second group of optical fiber switching units.
175. (Previously Presented) A switch according to claim 159 wherein the encoder comprises a lens which is located and shaped to focus the one or more control signal radiation patterns onto the reticle.
176. (Previously Presented) A switch according to claim 175 wherein the lens is located and shaped to couple an optical communication signal from a selected one of a plurality of optically opposed switching units into the optical fiber of its associated switching unit.

177. (Previously Presented) A switch according to claim 175 wherein the lens is located and shaped to collect an optical communication signal emitted from its associated optical fiber and direct the optical communication signal towards a selected one of a plurality of optically opposed switching units.
178. (Previously Presented) A switch according to claim 159 wherein the reticle is coupled to move with its associated optical fiber, and wherein the one or more corresponding Moiré interference patterns vary in intensity based on a position of the reticle.
179. (Previously Presented) A switch according to claim 178 comprising a controller connected to receive the corresponding control signal from the radiation sensor and configured to determine a position of the optical fiber based on the corresponding control signal.
180. (Previously Presented) A switch according to claim 159 wherein the reticle is coupled to move with its associated optical element, and wherein the one or more corresponding Moiré interference patterns vary in intensity based on a position of the reticle.
181. (Previously Presented) A switch according to claim 180 comprising a controller connected to receive the corresponding control signal from the radiation sensor and configured to determine a position of the optical element based on the corresponding control signal.

182. (Currently Amended) ~~A switch according to claim 43~~ An optical fiber cross-connect switch comprising first and second groups of optical fiber switching units, disposed in optically opposing relation, each of the switching units in at least one of said first and second groups further comprising:  
an optical fiber operative to conduct optical signals; and  
a position encoder operative to detect a Moiré interference pattern and determine therefrom a position of at least one of: (i) an end of said optical fiber; (ii) an optical element operative to influence an optical path of optical signals associated with said fiber; and (iii) a plurality of optical elements operative to influence an optical path of optical signals associated with said signal emitted from or coupled into the fiber;  
wherein each of the switching units in at least one of the first and second groups further comprises an actuator having a magnetic member coupled to move with the optical fiber and a plurality of magnetically polarizable branches spaced apart around the magnetic member.
183. (Previously Presented) A switch according to claim 182 wherein the magnetic member is circularly symmetric.
184. (Previously Presented) A switch according to claim 183 wherein the magnetic member comprises a ring of magnetic material.
185. (Previously Presented) A switch according to claim 184 wherein the encoder comprises a reticle having a spatially varying pattern of interaction with radiation incident thereon and wherein the ring extends around a peripheral edge of the reticle.
186. (Previously Presented) A switch according to claim 185 wherein the ring comprises a ferrite material.
187. (Previously Presented) A switch according to claim 183 wherein the actuator comprises four branches which are

equally spaced apart around the magnetic member.

188. (Currently Amended) ~~A method according to claim 38 comprising:~~ A method for switching an input optical signal between any of a plurality of output signal channels in an optical cross-connect switch, the method comprising:

generating one or more output Moiré interference patterns using first control signal radiation, the one or more output Moiré interference patterns varying with a position of the a receiving end of the one of said output signal channels;

detecting at least a portion of the one or more output Moiré interference patterns; and

based at least in part on the detected portion of the one or more output Moiré interference patterns, determining the position of the receiving end of the one of said output signal channels.

189. (Previously Presented) A method according to claim 188 wherein generating one or more output Moiré interference patterns comprises projecting the first control signal radiation onto an output reticle coupled to move with the one of said output signal channels, the output reticle having a spatially varying pattern of interaction with radiation incident thereon.

190. (Previously Presented) A method according to claim 189 wherein determining the position of the receiving end of the one of said output signal channels comprises determining a position of the output reticle.

191. (Currently Amended) A method according to claim 190 comprising:

generating one or more input Moiré interference patterns using second control signal radiation, the one or more input Moiré interference patterns varying with a position of the a transmitting end of the an input signal channel associated with said input optical signal;

detecting at least a portion of the one or more input Moiré interference patterns; and

based at least in part on the detected portion of the one or more input Moiré interference patterns, determining the position of the transmitting end of the input signal channel associated with said input optical signal.

192. (Previously Presented) A method according to claim 191 wherein generating one or more input Moiré interference patterns comprises projecting the second control signal radiation onto an input reticle coupled to move with the input signal channel, the input reticle having a spatially varying pattern of interaction with radiation incident thereon.
193. (Previously Presented) A method according to claim 192 wherein determining the position of the transmitting end of the input signal channel comprises determining a position of the input reticle.
194. (Previously Presented) A method according to claim 193 wherein each of the input and output reticles have a spatially varying transmissivity and wherein detecting at least a portion of the one or more output Moiré interference patterns comprises detecting a portion of the first control signal radiation which has passed through the output reticle and detecting at least a portion of the one or more input Moiré interference patterns comprises detecting a portion of the second control signal radiation which has passed through the input reticle.

195. (Previously Presented) A method according to claim 193 wherein each of the input and output reticles have a spatially varying reflectivity and wherein detecting at least a portion of the one or more output Moiré interference patterns comprises detecting a portion of the first control signal radiation which has reflected from the output reticle and detecting at least a portion of the one or more input Moiré interference patterns comprises detecting a portion of the second control signal radiation which has reflected from the input reticle.
196. (Previously Presented) A method according to claim 193 wherein each of the input and output reticles is patterned with a regular array of cells.
197. (Previously Presented) A method according to claim 196 wherein each cell of the array of cells comprises an aperture portion and an opaque portion and wherein:
- (a) detecting at least a portion of the one or more output Moiré interference patterns comprises detecting a first proportion of the first control signal radiation that is incident on and passes through the aperture portion and detecting a second proportion, smaller than the first proportion, of the first control signal radiation that is incident on and passes through the opaque portion; and
  - (b) detecting at least a portion of the one or more input Moiré interference patterns comprises detecting a first proportion of the second control signal radiation that is incident on and passes through the aperture portion and detecting a second proportion, smaller than the first proportion, of the second control signal radiation that is incident on and passes through the opaque portion.

198. (Previously Presented) A method according to claim 193 wherein each of the input and output reticles comprises a circularly symmetric pattern of aperture areas and opaque areas and wherein:
- (a) detecting at least a portion of the one or more output Moiré interference patterns comprises detecting a first proportion of the first control signal radiation that is incident on and passes through the aperture areas and detecting a second proportion, smaller than the first proportion, of the first control signal radiation that is incident on and passes through the opaque areas; and
  - (b) detecting at least a portion of the one or more input Moiré interference patterns comprises detecting a first proportion of the second control signal radiation that is incident on and passes through the aperture areas and detecting a second proportion, smaller than the first proportion, of the second control signal radiation that is incident on and passes through the opaque areas.
199. (Previously Presented) A method according to claim 193 wherein projecting the first control signal radiation onto the output reticle comprises projecting a plurality of elongated stripes of radiation onto the output reticle and projecting the second control signal radiation onto the input reticle comprises projecting a plurality of elongated stripes of radiation onto the input reticle.
200. (Previously Presented) A method according to claim 193 wherein projecting the first control signal radiation onto the output reticle comprises projecting one or more spatially periodic radiation patterns onto the output reticle and projecting the second control signal radiation onto the input reticle comprises projecting one or more spatially periodic radiation patterns onto the input reticle.

201. (Previously Presented) A method according to claim 196 wherein projecting the first control signal radiation onto the output reticle comprises projecting one or more spatially periodic radiation patterns onto the output reticle, the spatially periodic radiation patterns having a period substantially equal to a spatial periodicity of the cells of the array of cells of the output reticle and projecting the second control signal radiation onto the input reticle comprises projecting one or more spatially periodic radiation patterns onto the input reticle, the spatially periodic radiation patterns having a period substantially equal to a spatial periodicity of the cells of the array of cells of the input reticle.
202. (Previously Presented) A method according to claim 201 wherein the cells of the arrays of cells of the input and output reticles are arranged in rows extending substantially parallel to a first axis and columns extending substantially parallel to a second axis and wherein projecting the first control signal radiation onto the output reticle comprises projecting elongated stripes of radiation which are oriented substantially parallel to one of the first and second axes and projecting the second control signal radiation onto the input reticle comprises projecting elongated stripes of radiation which are oriented substantially parallel to one of the first and second axes.
203. (Previously Presented) A method according to claim 193 wherein projecting the first control signal radiation onto the output reticle comprises projecting at least one radiation pattern having a first wavelength onto the output reticle and projecting at least one radiation pattern having a second wavelength onto the output reticle and wherein projecting the second control signal radiation onto the input reticle comprises projecting at least one radiation pattern having the first wavelength onto the input reticle and projecting at least one radiation pattern having the second wavelength onto the input reticle.

204. (Previously Presented) A method according to claim 193 wherein projecting the first control signal radiation onto the output reticle comprises imaging a plurality of individual radiation emitting devices onto the output reticle and wherein projecting the second control signal radiation onto the input reticle comprises imaging a plurality of individual radiation emitting devices onto the input reticle.
205. (Previously Presented) A method according to claim 189 comprising moving the receiving end of the one of said output signal channels to a position that substantially maximizes the coupling of said input optical signal into the one of said output signal channels.
206. (Previously Presented) A method according to claim 193 comprising moving the receiving end of the one of said output signal channels to a position that substantially maximizes the coupling of said input optical signal into the one of said output signal channels.
207. (Previously Presented) A method according to claim 206 comprising moving the transmitting end of the input signal channel associated with said input optical signal to a position that substantially maximizes the coupling of said input optical signal into the one of said output signal channels.
208. (Cancelled)

209. (Currently Amended) ~~A method according to claim 208~~  
comprising A method for switching an optical  
communication signal emitted from a first optical fiber  
between any of a plurality of second optical fibers in an  
optical cross-connect switch, said method comprising:  
detecting one or more Moiré interference patterns  
and determining therefrom a position of a moveable  
optical element, the position of the moveable optical  
element influencing an optical path between said first  
optical fiber and one of said second optical fibers; and  
generating the one or more Moiré interference  
patterns by projecting control signal radiation onto a  
reticle coupled to move with the moveable optical  
element, the reticle having a spatially varying pattern  
of interaction with radiation incident thereon.
210. (Previously Presented) A method according to claim 209  
comprising determining a position of the moveable optical  
element by determining a position of the reticle.
211. (Previously Presented) A method according to claim 210  
comprising moving the moveable optical element to a  
position that substantially maximizes the coupling of the  
optical communication signal between said first optical  
fiber and the one of said second optical fibers.
212. (Currently Amended) ~~A method according to claim 39~~  
~~wherein the plurality of optical elements operative to~~  
~~influence an optical path between said first optical~~  
~~fiber and the one of said second optical fibers comprises~~  
A method for switching an optical communication signal  
emitted from a first optical fiber between any of a  
plurality of second optical fibers in an optical cross-  
connect switch, said method comprising detecting one or  
more Moiré interference patterns and determining  
therefrom positions of a plurality of moveable optical  
elements, and wherein the respective positions of the  
plurality of moveable optical elements influence the  
influencing an optical path between said first optical  
fiber and the one of said second optical fibers.
213. (Currently Amended) A method according to claim 212

comprising generating the one or more Moiré interference patterns by projecting control signal radiation onto a plurality of reticles, each reticle coupled to move with a corresponding one of the plurality of moveable optical elements and each reticle having a spatially varying pattern of interaction with radiation incident thereon.

214. (Previously Presented) A method according to claim 213 comprising determining the respective positions of the plurality of moveable optical elements by determining respective positions of their corresponding reticles.
215. (Previously Presented) A method according to claim 214 comprising moving the plurality of moveable optical elements to positions that substantially maximize the coupling of the optical communication signal between said first optical fiber and the one of said second optical fibers.